



Armed Forces College of Medicine AFCM



Lymphatic System

Lymphatic nodules

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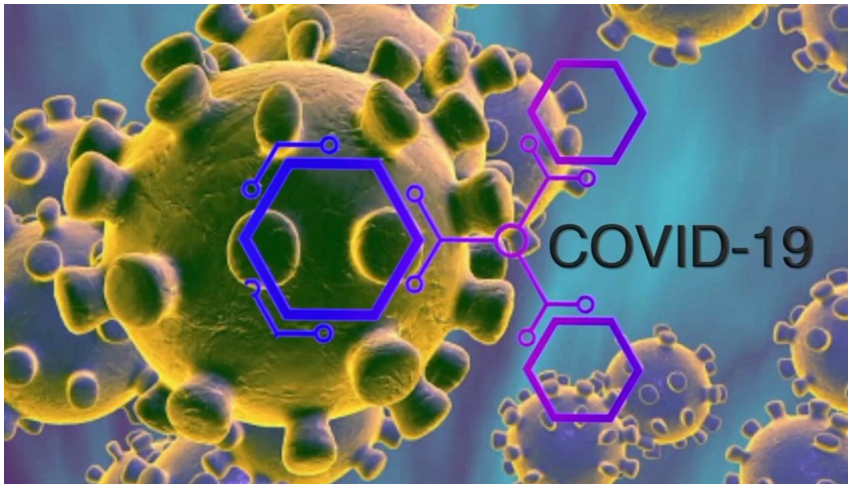
- **By the end of this lecture you should be able to:**
 1. **Classify lymphatic tissues.**
 2. **Describe** the microscopic structure of the different **cells** involved in immune response.
 3. **Correlate the structure of antigen presenting cells to their mechanism of action.**
 4. **Describe the histological features of lymphoid nodules.**
 5. **Correlate the structure to the function of tonsils.**

The Immune System

Lymphatic System



- ✓ Consists of organs and cells that protect the body from harmful foreign substances (eg. microorganisms).
- ✓ It is the defense system of the body.



Coronavirus



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Defense mechanism



Innate immune system

- **Non specific**
- Cells: **neutrophils & macrophages**
- **Same intensity every time**

Adaptive immune system

- **Specific**
- Cells: **lymphocytes**
- **Intensity of response increase on secondary**



Adaptive Immune System Types of immune response

Humoral immunity

Mediated by

B lymphocytes

The cells change to plasma cells which produce

Antibodies

Cellular immunity

- Mediated by **T lymphocytes**
- The cells react and kill micro-organisms, tumor cells & virus

Cells of the Immune System



1-Lymphocytes

- a. B- Lymphocyte,
- b. T- lymphocyte,
- c. Natural killer cells

2- Antigen presenting cells

3- Macrophages

4- Plasma cells cells

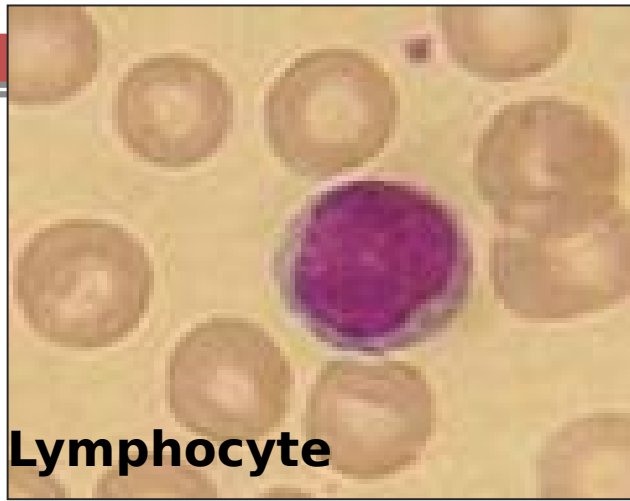
5- Reticular

6- Mast cells

7-

Neutrophils

Cells of the Immune System



Lymphocyte

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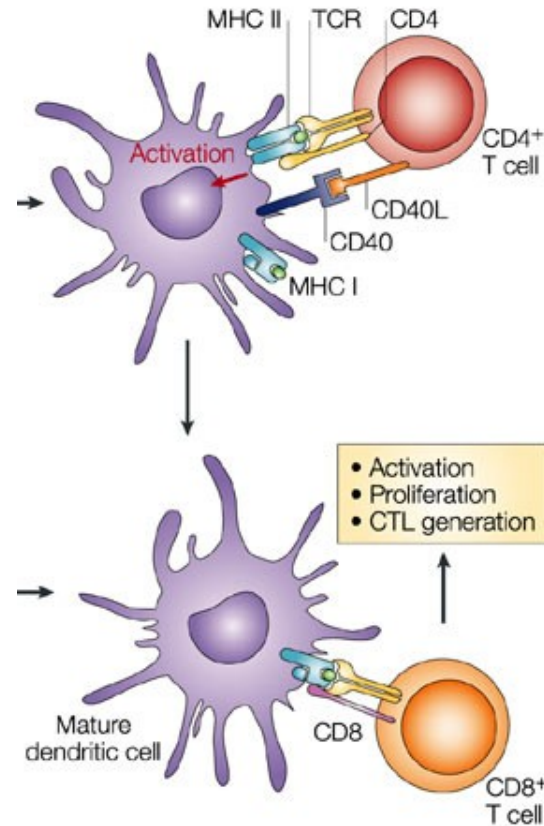
Plasma cell



New Five Year Program

<https://lh3.googleusercontent.com/G->

Ag presenting cell



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Immunology & Blood



Macrophage

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Antigen Presenting Cells



- **Origin:** Bone marrow
- **Definition:** Group of cells that phagocytose, process antigens and present them to lymphocytes.

APCs phagocytose Antigen and partially process it.

Express the most antigenic part of the Ag
“**epitope**” on their surface attached to
MHC II receptors and present this
complex to
T-helper cell

T helper cell receptors can only interact
with cells that have **MHC II- antigen
complex**

Antigen Presenting Cells

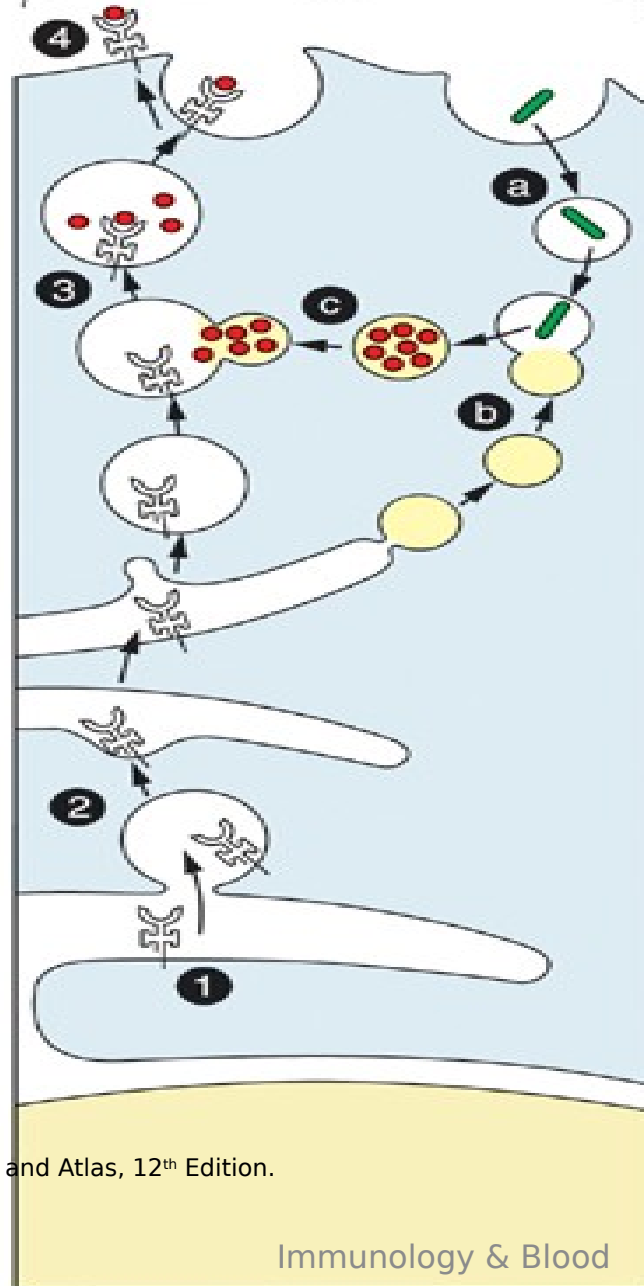


4-Presentation on surface

3-Fusion of Golgi vesicle to secondary lysosome

2-Transfer of MHC II to Golgi

1-Synthesis of MHC II in RER

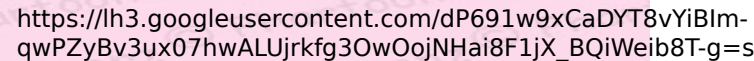


a- Endocytosis of a micro-organism

b- Fusion of endocytosed vesicle with lysosomes

c- Processing of Ag (red) In the secondary lysosome

Antigen presenting cell

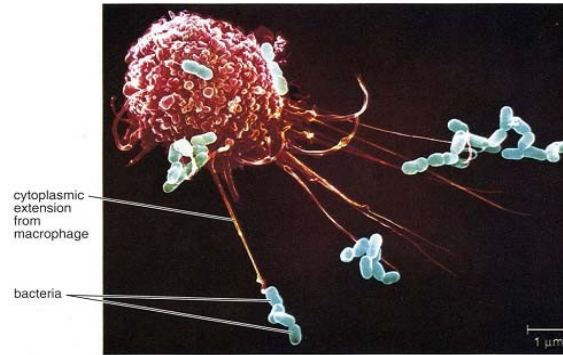


Antigen Presenting Cells

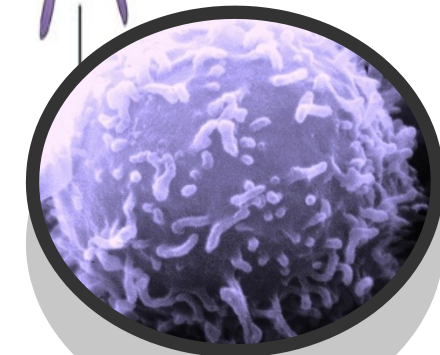
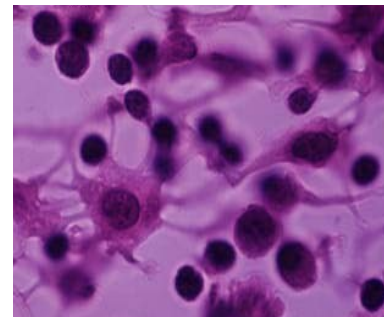
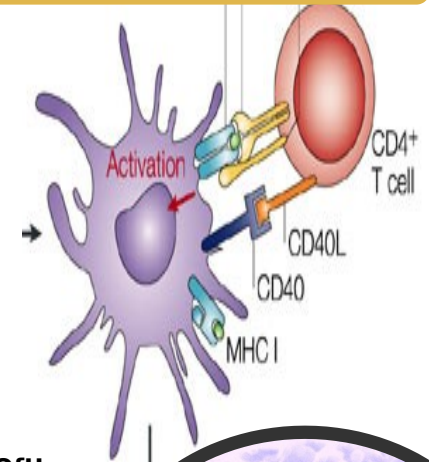


Antigen presenting cells include:

1. Macrophages
2. B-lymphocytes
3. Dendritic cells → lymph node and spleen.
4. Epithelial cells → reticular cells in Thymus.
5. Langerhan's cells → in the epidermis of skin.

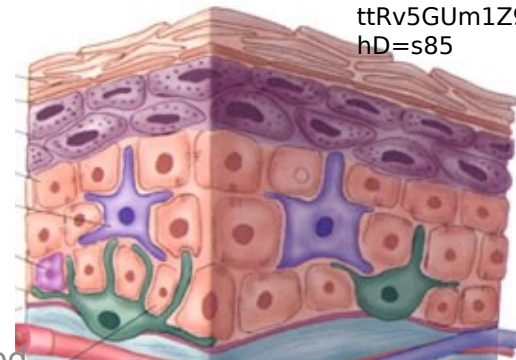


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hD=s85



Mescher AL: Junqueira's Basic Histology:
Text and Atlas, 12th Edition.
<http://www.accessmedicine.com>

True or False (Activity)

1- Antigen presenting cells phagocytose antigens, process them and present them to B lymphocytes. **False**

2- Antigen **False** presenting cells include B lymphocytes and plasma cells.

3- The main **True** characteristic feature of APCs is synthesis of class II MHC

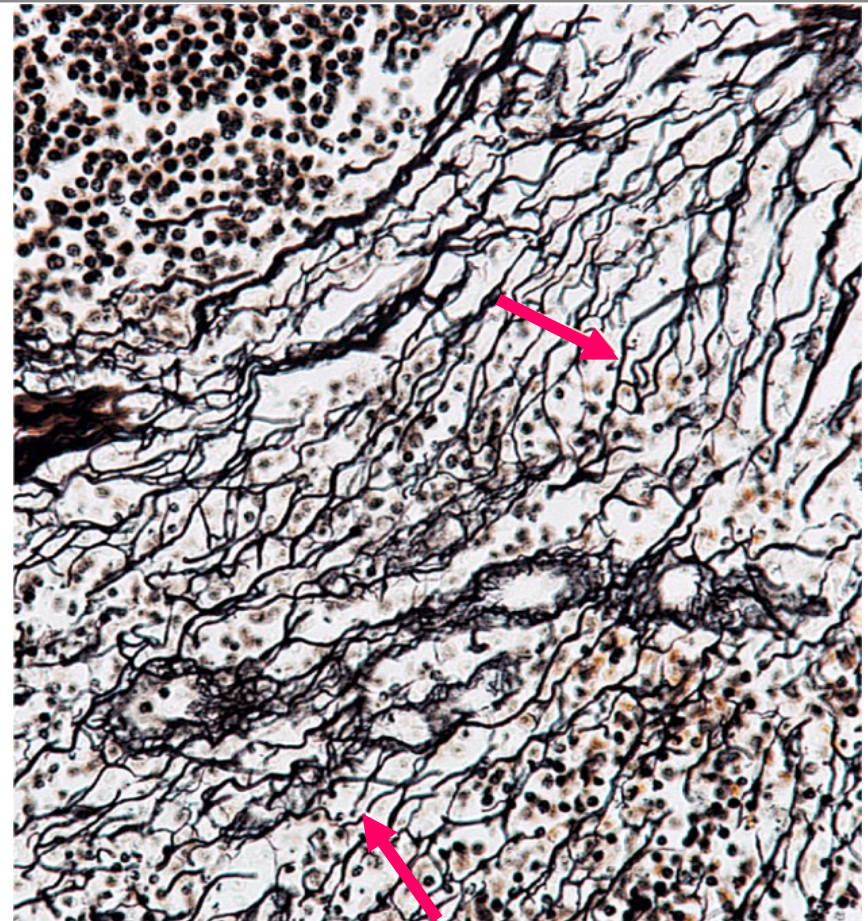
What is a lymphatic tissue?



□ Lymphatic tissue is formed of:

1- Meshwork of reticular fibers and reticular cells

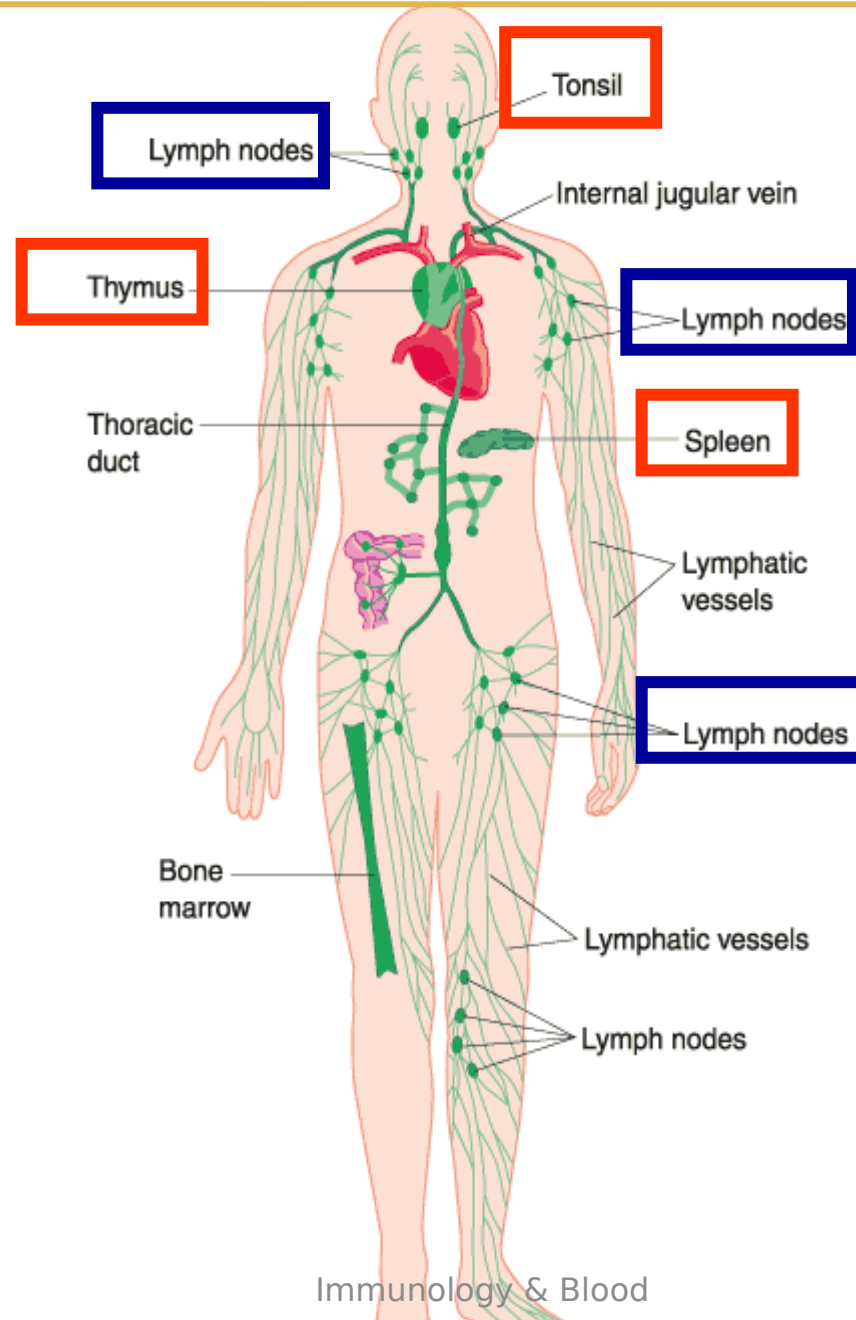
2-The spaces between the meshwork are occupied by a large number of lymphocytes



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3-There are other cells present in

The Lymphatic System



LYMPHOID TISSUE



```
graph TD; A[LYMPHOID TISSUE] --> B[I. capsulated]; A --> C[II. Non Capsulated]; B --> D[Thymus]; B --> E[Lymph node]; E --> F[Spleen]; C --> G[Solitary]; C --> H[Aggregated]; H --> I[Peyer's patch]; H --> J[Appendix]; H --> K[Tonsils];
```

The diagram is a hierarchical flowchart. At the top is a purple box labeled 'LYMPHOID TISSUE'. A line from this box branches into two orange boxes: 'I. capsulated' on the left and 'II. Non Capsulated' on the right. From 'I. capsulated', a line leads to a red box 'Thymus', and another line leads to a red box 'Lymph node'. From 'Lymph node', a line leads to a red box 'Spleen'. From 'II. Non Capsulated', a line branches into two blue boxes: 'Solitary' and 'Aggregated'. From 'Aggregated', a line leads to a red box 'Peyer's patch', another line leads to a red box 'Appendix', and a third line leads to a red box 'Tonsils'.

I. capsulated

Thymus

Lymph
node

Spleen

II. Non Capsulated

Solitary

Aggregated

Peyer's
patch

Appendi
x

Tonsils

Primary & Secondary lymphoid organs

Primary lymphoid organs:

- ✓ Thymus and bone marrow.
- ✓ It is where Lymphocytes are formed initially.

Secondary lymphoid organs:

- ✓ Lymph nodes, spleen, and diffuse lymphoid tissue in the mucosa of the digestive system, including the tonsils, Peyer patches, and appendix and other mucosa-associated lymphoid tissue (MALT).
- ✓ It is where there is lymphocyte activation and proliferation occurs.

Mucosa-associated lymphoid tissue (MALT)



- It is formed of lymphocyte infiltration and lymphoid nodules in the mucosa of
 - Gastro-intestinal tract (GALT)
 - Respiratory tract
 - Genitourinary tract

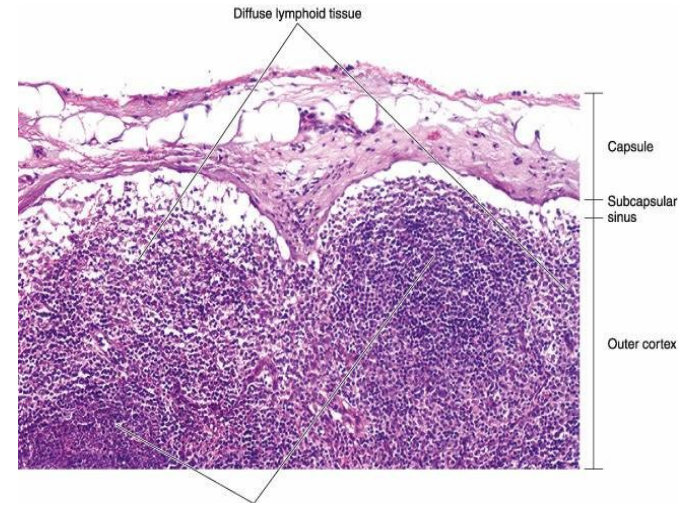


Lymphoid Nodules



They are aggregations of lymphatic tissue in a follicle.

Each nodule is formed of **stroma of reticular fibers and reticular cells** in which cells are suspended.



Mescher AL: Junqueira's Basic Histology: Text and Atlas, 12th Edition.
<http://www.accessmedicine.com>

Cells present:

- **B-lymphocytes**
- **T-helper lymphocytes**
- **Macrophage**
- **Dendritic cells**
- **Reticular cells**

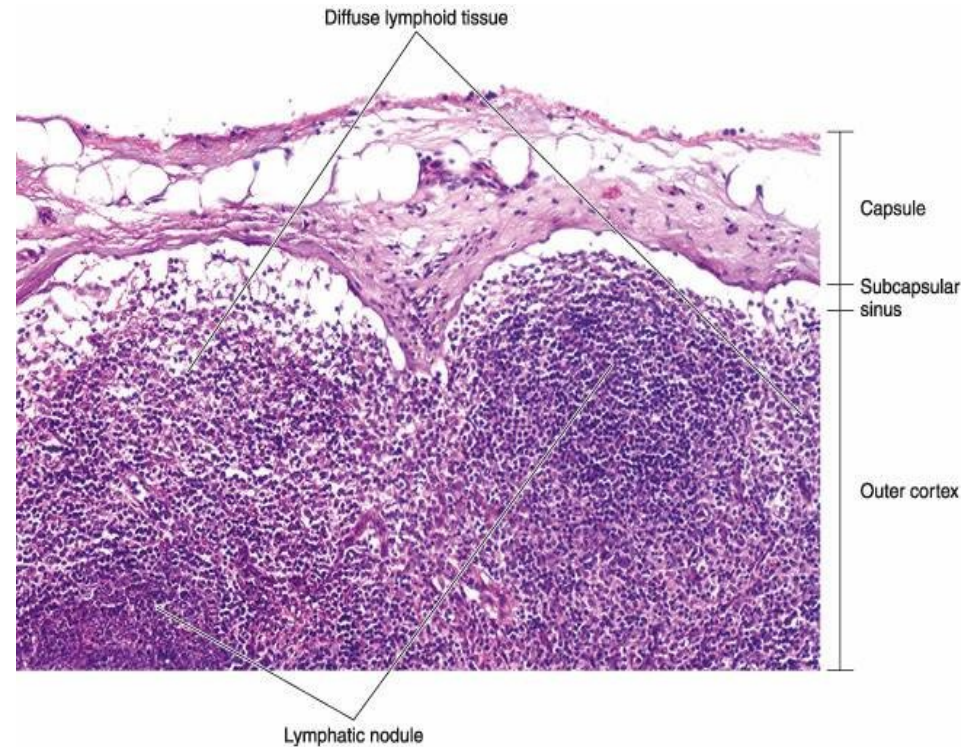
Lymphoid Nodules



2 Types:

1. Primary

Small oval, rounded or pyramidal without a germinal center (Homogenous in density, formed mainly of B lymphocytes & Follicular dendritic cells (have long processes and lack MHC II complex))



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Lymphoid Nodules

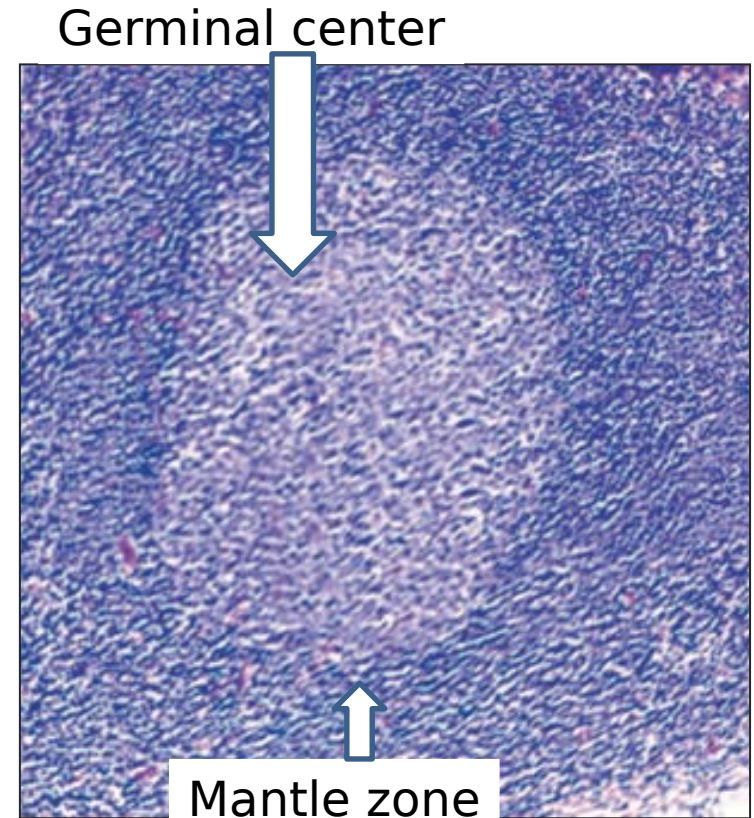


2. Secondary

**Dark periphery
(mantle zone) and
pale central region
(germinal center)**

Germinal center:

**Activated B
lymphocytes,
T-helper lymphocytes,
Macrophages,
Dendritic cells,
Plasma cells**



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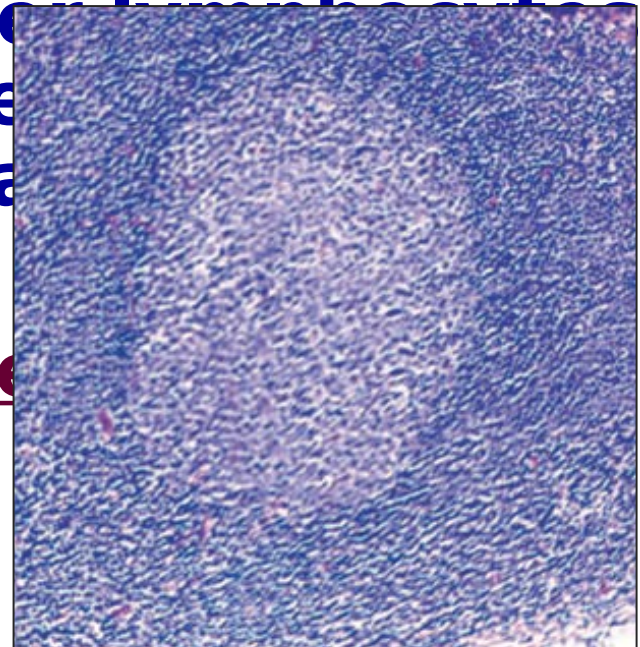
Lymphoid Nodules



Secondary lymphatic nodules

- They are formed in response to **antigens**.
- B-lymphocytes react with antigen → increase in size, proliferate by mitosis → larger lymphocytes which aggregate in the plasma nodule.

Why are germinal centers

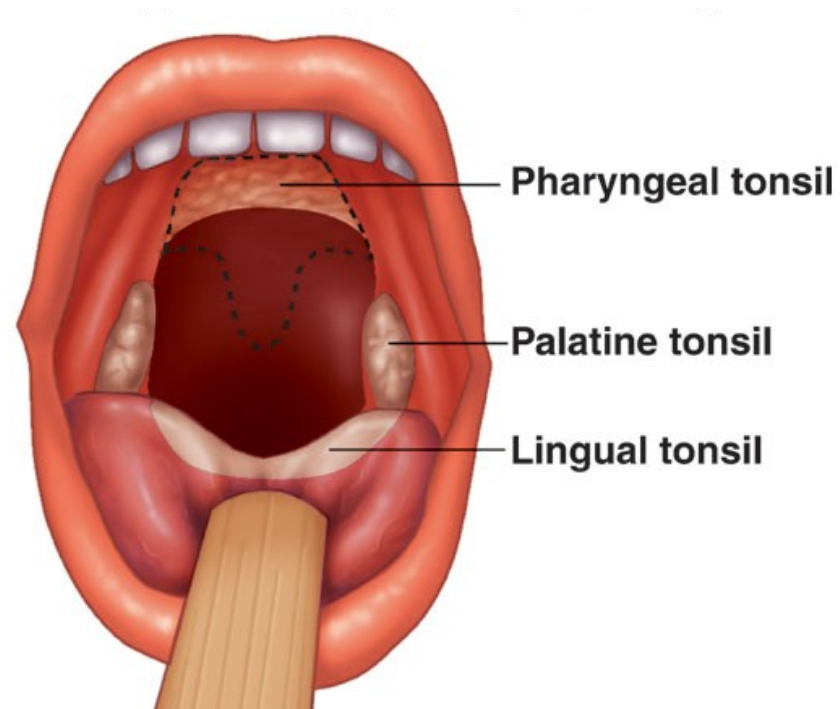


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Tonsils



- ❑ **Aggregates of lymphoid tissue incompletely encapsulated.**
- ❑ **Beneath the epithelium of the initial portion of GIT**
- ❑ **Types:**
 - Palatine (2)**
 - Pharyngeal (1)**
 - Lingual (numerous)**

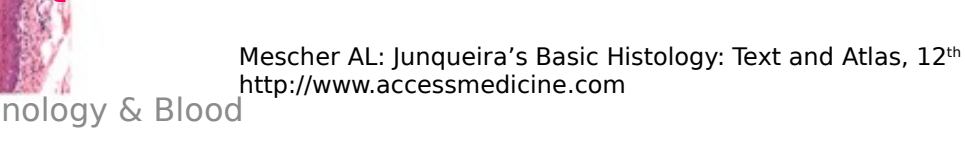


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Palatine Tonsil



- **In lateral wall of the oropharynx.**
- **Consists of:**
 - 1) Stratified Sq. epithelium (non-keratinized) with crypts (primary and secondary).**
 - 2) Lymphoid tissue (Follicles and diffuse).**
 - 3) Capsule separates the tonsils from the surrounding structures.**



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<http://www.accessmedicine.com>

Pharyngeal Tonsil



- **Single in the back of the nasopharynx**
- **Consists of:**
 - 1) Pseudostrat. Columnar ciliated epith with goblet cells (shallow longitudinal folds, no crypts)**
 - 2) Lymphoid tissue (Follicles and diffuse).**
 - 3) Seromucous glands open in the folds covered by incomplete**

Lingual Tonsil



- They are small and numerous.
- At the root of the tongue.
- Covered by stratified squamous non-keratinized epithelium.
- Each tonsil has a **single crypt**, its base receives the duct of minor salivary glands.
- Lymphoid tissue (Follicles and diffuse).

Function of the Tonsils



- **They represent the first line of immunological defense against infectious micro-organisms or antigens.**

Pharyngeal Tonsil



Compare between palatine, pharyngeal and lingual tonsils

Lingual	Pharyngeal	Palatine	
Base of tongue	Back of nasopharynx	Lateral wall of oropharynx	Site
Stratified squam. Non keratinized	Pseudo stratif. colum. Ciliated with goblet cells	Stratified squam. Non keratinized	Covering epithelium
One crypt	Folds and no crypts	Primary and secondary crypts	Crypts

Mononuclear Phagocytic System

- **Have common origin (monocytes), same structure and same function.**
- **Monocytes develop in the bone marrow** 

 **blood**

Connective tissue

- **Types**

Macrophages

Kupffer cells in the liver

Dust cells in the lung

Microglia in the CNS

Langerhan's cells in skin

Method of staining: Vital staining

True or False

1-Primary lymphatic nodules are active nodules and homogenous in density

False

2- Secondary lymphatic nodules have germinal centers.

True

3-The epithelium lining the pharyngeal tonsil is stratified squamous epithelium

False

4- Activated B lymphocytes are found in secondary lymphatic nodules

True

Question



- **All of the following cells belong to the mononuclear phagocytic system EXCEPT:**

- 1. Dust cells in lungs**
- 2. Kupffer cells in liver**
- 3. Microglia in CNS**
- 4. Plasma cells in CT**
- 5. Macrophages in CT.**

Question



➤ **Which of the following are Antigen presenting cells?**

A. Neutrophils

B. T lymphocytes

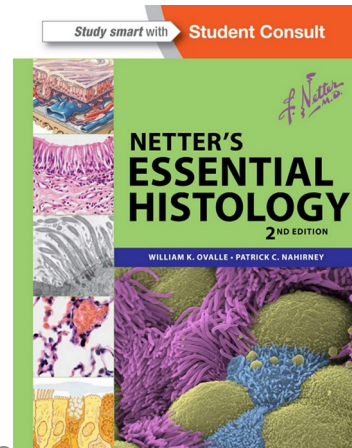
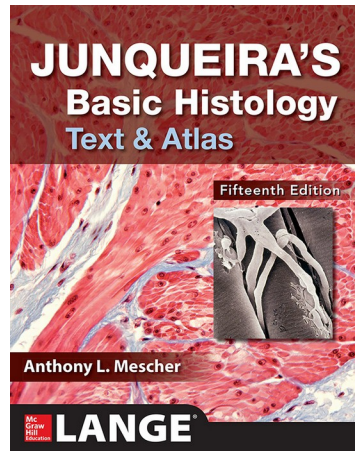
C. Plasma cells

D. B lymphocytes

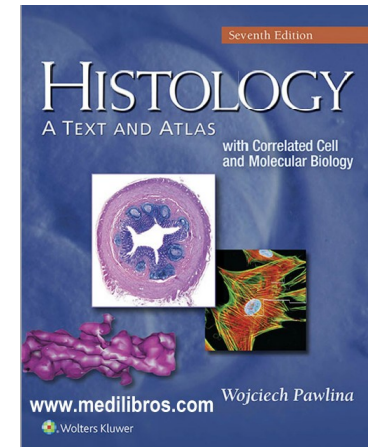
SUGGESTED TEXTBOOKS



1. **Junqueira's Basic Histology: Text and Atlas, 16th Edition by Anthony Mescher, 2018.**
2. **Michael H. Ross & Wojciech Pawlina (2024), Histology Text and Atlas with correlated cell and Molecular Biology, 7th Edition.**



Endocrine & Genitourinary Module





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